INSTRUCTIONAL CUM PRACTICAL MANUAL

ON

WEEDS & WEED CONTROL

Contributors

Dr.O.P.GUPTA

Dr.M.K.MATHUR

Mr.M.THANIKODY

Mr.G.L.SHARMA

Dr.J.N.BAJPAI

Dr.A.K.BHOTE[illegible]

Dr.A.K.SACHETI

VOCATIONALIZATION OF EDUCATION UNIT
National Council of Educational Research & Training
Sri Aurobindo Marg, New Delhi -110016

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PREFACE

Ever since the introduction of vocationalization in our school system by several States in our country the paucity of appropriate instructional materials has been felt as one of the major constraints in implementation of the programme and a source of great hardship to pupils offering vocational studies at the higher secondary stage.

The Vocationalization of Education Unit of the National Council of Educational Research and Training, New Delhi has started a modest programme of developing instructional materials of diverse types to fill up this void in all major areas of vocational education. The task is too gigantic to be completed by any single agency but the model materials being developed by us might provide guidance and impetus to the authors and agencies desiring to contribute in this area. These are based on the national guidelines developed by a working group of experts constituted by NCERT.

The present manual is on "Weeds and Weed Control" and is common portion of the crop production/general agriculture or related courses in a number of States. It contains activities (Practical exercises) to be performed by pupils with simple steps to follow, precautions to be taken and data to be obtained and processed. Each activity is complete with brief theoretical information, objectives, behavioural outcome, evaluation etc. It is hoped that the pupils will find them immensely useful.

The pages that follow contain a draft of the writing which will be finalized after obtaining the responses and back from pupils, teachers and others concerned. The mate will then be published in the printed form.

The users are requested to complete the questionnaire appended and return it to us. Comments and suggestions fo improvement of the materials are also welcome.

The material has been developed by a group of experts as authors in a workshop held at the Directorate of Extens Education, University of Udaipur, Udaipur, Rajasthan. The names are mentioned elsewhere and their contributions are admirably acknowledged. Dr. A.K.Sacheti, Reader and Dr. A.K.Dhote, Lecturer, V.E.Unit deserve special thanks f editing and bringing the materials in the present form. T assistance of all in the Directorate of Extension Educatio University of Udaipur, Udaipur and Vocationalization of Education Unit, NCERT is also thankfully acknowledged.

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ARUN K. MISHRA
Professor and Head
Vocationalization of Education Un
National Council of Educational Rese
Training, New Delhi - 110016

INTRODUCTION

About 17 different groups of vocational courses in agriculture area have been introduced by the six States and three Union Territories, so far. These courses are in vogue for the last 4 --5 years. From the very beginning, the Vocationalization of Education Unit of NCERT is working hand in hand with the State functionaries through various programmes organised for the State officials, vocational teachers and others. In fact, by now the Unit has conducted on-the-spot studies of vocational programmes for all the States except Tamil Nadu to find out the merits and demerits of the programme and to suggest appropriate measures to solve the issues pertaining to the scheme. Beside these studies, the Unit has also organised short-term teacher training programmes in agriculture. All these programmes have revealed that there is a great dearth of suitable textual instructional materials, specially the need of practical manuals was urgently felt. Supply of instructional materials and imparting of practical training becomes still more essentia when one looks at the purpose with which the vocationalization of education scheme has been launched. The main aim is to prepare the pupil for purposeful and gainful employment (wage or self-employment).

To develop models of instructional materials, the Unit constituted a Working Group to formulate guidelines for the development of different types of instructional materials and to prepare brief examplar units.

Based on the guidelines supplied by the Working Grou crop production, which is an important and popular vocati course in agriculture was selected for the purpose of development of instructional materials in phased manner. begin with, development of instructional-cum-practical ma was taken up. Later, the work of teacher's guide develop and text books writing shall also be taken up.

The content of the crop production and similar cours offered by the States and Union Territories under differe titles was thoroughly analysed and it was felt appropriat to develop six such manuals to cater to the needs of the course. The present manual is one of them. While develo the manual, care was taken that it should include maximum number of activity Units (practical exercises) so that it fulfills the requirements of the course prescribed by the States and Union Territories in the crop production group of courses and also other vocational courses. Crop produ group includes courses like crop science/principles of cr production/agriculture.

This manual is envisaged to help both teachers and pupils in the pursuit of weeds and weed control, a part o vocation. It explains 'what', 'why' and 'how' of the act

Units which are essential to develop required vocational skills in the students.

In the manual each activity Unit has been dealt in several sub-heads, viz., instructional objectives, relevant information, precautions, materials required, procedure, observations, expected behavioural outcome and questions.

Before commencing with actual work for any activity Unit, the teacher should know what exactly pupils have to learn and do and whether they will be able to do that? Therefore, in the beginning instructional objectives in behavioural terms should be framed by the teacher for the students.

In order to acquaint the pupils about the activity Unit the teacher should provide them with required theoretical knowledge or information relevant to the activity. This will help the pupil in proper understanding of the activity Unit. In other words 'what' and 'why' part of the activity Unit should be explained well in advance by the teachers.

Once the pupils have understood, the relevant theoretical informations, the teacher should tell them about the precautions which are to be followed before and during actual execution of the activity Unit. This will facilitate their smooth working. 'How' part of the manual will be described in the 'procedure' which pupil will follow while performing the activity Unit.

Under the sub-head 'observations', the pupil shall observe the situation, take readings, and similar other points as suggested under each Unit which may vary from Unit to Unit. Wherever calculations are required to be done to obtain the results, they are also mentioned under this head.

At the end of the activity, the pupil shall acquire certain abilities which should be closely related with instructional objectives given under each activity Unit. These abilities shall be listed under the sub-head 'expected behavioural outcome. Evaluation shall be based on the abilities acquired and it will be done by the concerned teachers.

For evaluating each aspect, the teacher will use 4 point scale i.e. A, B, C & D and for each activity Unit Grade Point Average can be calculated as indicated below:

Suppose there are f ur aspects or abilities and each carries equal weightage and a student obtains 2A's, 1 C and 1 D and if A = 4 point, B = 3 point, C = 2 point, D = 1 point, based on the grades the pupil will get 11 points and when this is divided by the total number of aspects examined it will give grade point average, in this case it is 2.75. Tabular presentation is as under:

Aspect/ Ability	Weightage	Grades Obtained	Total points Weightage x point equi- valent to grade obtained		Grade point average	
1	1	A	1x4	4		
2	1	C	1x2	4	$\frac{11}{4}$	2.75
3	1	D	1x1	1		
4	1	A	1x4	4		
				11		

A = 4 point, B = 3 point, C = 2 point, D = 1 point

In the last, some questions related with the activity Units are also given, the students shall write the appropriate answers after the completion of the activity Unit and teacher shall examine them. If required, he shall do suitable corrections and give suggestions. However, answer to these questions will not be considered for the purpose of grading.

IMPORTANCE OF WEED & WEEDS CONTROL

Much advancements have been made in the development of agricultural technology in India during the last couple of decades, particularly in the field of developing high yielding crop varieties and fertilizer use. However, weeds continue to bother our farmer as a major negative factor in his crop production, draining out the benefits of costly, modern inputs in agriculture.

Weeds compete with the crop plants for essential nutrients, water, and light, and reduce their yield potential tremendously. In many weedy fields almost complete loss of crops is not uncommon. Besides reducing the yield of crops, the weeds reduce their quality by shrivelling the grains and decolouring the fruits and vegetables. They harbour and intensify insect pest and disease pathogens. Spiny weeds make crop harvests cumbersome and in grasslands they annoy the grazing animals. Growing with forage crops, many weeds are responsible for deteriorating the quality of animal produce and sometimes intoxicating them.

On non-croplands, weeds are responsible for causing human diseases like hay fevers and dermatitis. In water bodies, excessive growth of plants into weedy stands bring to a halt every kind of utility of the water therein.

In summary, in our every walk of life weeds matter a lot to us, directly or indirectly. The total losses incurred by man due to weeds in terms of rupees could amount to millions each year. Needless to say, such a pest of humanity must be brought under effective control.

Scientists have made considerable progress in the control of weeds in different situations, by a battery of methods including physical, chemical, biological, cultural and even those involving laser beams. In the modern concept of weed management all these methods must be conducted in proper combinations, depending upon the local needs, feasibility, and agro-economic situation. No one method is superior to the other; rather these are supplementary to each other. For instance, a combination of herbicide and physical methods generally proves much more effective than either used alone. For each situation we must be able to find out which one of these combinations would fit most and one should be able to develop a fruitful feasible, an economic sequence of control measures.

Probably as is true for other modern technologies, the theory of weed control methods will not lead us any where, unless we have a fleet of young persons trained in the minutest details of field applications of various weed control methods. Even a simple thing like physical weed control with say a spike-tooth harrow or a cultivator, requires skill for obtaining best results. The skill requirement is even more for the use of herbicides and bioagents. Somehow, this aspect of weed management has been very much lacking so far in our country due to which our farmers feel hesitant to take to the modern weed control technology. Vocational training in weed control is thus a must, if we have to win over our this tyrant enemy of agriculture.

For any vocational training it is necessary that the trainer himself is equipped with a sequential list and details of field and laboratory exercises in black and white. This enables him to pre-arrange the materials needed for each exercise, and select out an exercise most relevant to the prevailing season and crop stages. Such a vocational training manual in weed control is completely lacking in India, and it is hoped that the present attempt shall fill-up this vaccum.

The exercises in this manual are intended to make the trainee conversant with the major weeds of crop and non-crop areas, and their propagation behaviour and aggresive nature. Detailed exercises have been provided for practising weed control with certain common implements and herbicides in specified crops. However, enough flexibility is provided for the teacher to mould these exercises to suit local crops and cropping conditions. Further, it was considered equally important to impart exercises in the safety measures, particularly in the use of herbicides. Therefore, relevant skill-oriented exercises have been further included in this manual.

After completing the vocational training in weed control and acquiring the necessary skill for the job, most trainees are supposed to adopt these practices usefully in crop production programmes where ever they are. However, besides this there is ample scope in the country to take-up contracts for weed control, particularly on large-sized farms, in industrial areas, and in like situations. The present manual on weed control should prove very useful in the over-all infra-structure of Learning to Earn.

1. Activity Unit : COLLECTION AND FAMILIARITY WITH LOCAL WEEDS

1.1 Instructional Objectives :

The pupil should be able to :

- acquire broad knowledge about weed species and intensity of their occurrence in the area.
- recognise the weeds and classify them in logical order.
- comprehend the relationship between weeds and the environment and describe the situation by visual observations.
- prepare a herbarium of weeds.

1.2 Relevant information :

- What is a weed :

Any plant growing out of place is a weed.

- Types of weeds .

The weeds may be crop specific or season specific i.e. annual, biennial and perennial weeds.

- Concept :

To be able to control weeds on farm effectively it is important that one is able to first identify them and know their growth behaviour. Intimate knowledge of weeds, their habitat, crop association and pockets of severe infestation assumes a new significance in this context. An activity unit comprising of three sub-units on familiarity chart, weed classification chart and herbarium preparation of weeds of the area will, therefore, put the pupils in right perspective for effective learning about the weeds.

1.3 Precautions :

- Select only such spots for collection which have fairly large concentration of weed species.
- Ensure that collection of weeds is done at right stage of growth, such as :
  - a) weeds collected must have all plant parts including flowers.
  - b) cruciferous weeds must contain pods
  - c) special parts containing important character must be there.

This activity Unit should be performed through the following sub-units

- preparation of general familiarity chart.
- preparation of weed classification chart.
- preparation of herbarium.

1a. Sub-unit : PREPARATION OF GENERAL FAMILIARITY CHART

1a.1 Procedure :

- Undertake survey of the area selected for weed collection.
- Know specific plot/locality from which weeds are collected.

- Find out crop association/immediate environment where weeds are collected.
- Find out local names of the weeds collected
- Determine whether weed is major or minor from the point of damage and spread.

1a.2 Observations :

The pupil should record the information in the following observation sheet :

contd.......p.13

Observation Sheet

Date of collection__________ Site of collection_

Specific plot/ locality from which weeds collected	Crop Association/ immediate environment where weeds found.	Local/Common names of the weeds collected	Whether weed is major or minor from point of damage	Whether weed is major or minor from point of spread.
(X)	(Potato)	1.________	Major	Minor
		2.________	Minor	Major
		3.________	Minor	Major
(Y)				

1a.3 Expected Behavioural Outcome :

The pupil acquires the following abilities:

	Grade
i. Ability to find out the extent of damage.	
ii. Ability to find out the extent of spread.	
iii. Ability to identify weeds in relation to crops	
iv. Know the common/local names of the weeds.	

The teacher should evaluate the pupil for the above abilities.

1a.4 Questions :

i. Name five important weeds of Maize crop.

ii. What are the common weeds of Paddy crop?

iii. Name two most common weeds of your area.

iv. Fill in the blanks.

.... is an important weed of potato crop.

.... is an important weed of sugarcane crop.

.... is an important weed of wheat crop.

.... is a most common weed of Kharif season.

.... is a most common weed of Rabi season.

1b. Sub-unit : PREPARATION OF WEED CLASSIFICATION CHART

1b.1 Procedure :

- Visit the farm in all the three important seasons.
- Study the seasonwise growth pattern of various weeds of the area
- Observe closely the host-weed association

1b.2 Observations :

The pupil should record the information seasonwise separately in following charts.

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Classification chart for Rainy season weeds

S. No.	Name of Weeds		Whether Annual/Biennial/Perennial	Host-weed association
	Common	Botanical Name		

Classification Chart for Winter season weeds

S.No.	Name of Weeds		Whether Annual/Biennial/Perennial	Host-weed association
	Common	Botanical Name		

Classification Chart for all season weeds

S.No.	Name of Weeds		Whether Annual/Biennial/Perennial	Host-weed association
	Common	/ Botanical Name		

1b.3 Expected Behavioural Outcome :

The pupil acquires the following abilities :

	Grade
i. Knows botanical names of the common weeds.	
ii. Knows ground behaviour of growth of the weeds.	
iii. Can classify weeds season-wise	
iv. Knows host-weed association.	

The teacher should evaluate the pupil for the above abilities.

1b.4 Questions :

i. Name five annual weeds

ii. Fill in the blanks

a)................... is a perennial weed found on the boarders of cultivated fields.

b)................... is an annual weed found in wheat field.

c)................... is a biennial weed found in cultivated fields.

d) Achyranthus.aspera is a.......................weed

e) Xanthium strumarium is a.......................weed

Ic. Sub-unit : PREPARATION OF HERBARIUM

1c.1 Relevant Information :

Herbarium is a collection of most representative specimens of weeds in a pad (album)

- Importance of herbarium :

It is a very good learning material not only for the pupils who prepare it, but also for others who want to use it for a variety of purposes.

1c.2 Materials required :

i) Field Note Book
ii) Old Newspaper sheets
iii) Collection-bag
iv) Herbarium sheets
v) Pressing device
vi) Sticking material/adhesive
vii) Weed identification manual
viii) Old-herbaria

1c.3 Procedure :

- Select a fresh specimen having all important parts of the plant.
- Spread the specimen in its natural form on a sheet of paper which can absorb moisture (e.g. blotting paper) and put under a press (or in between two smooth surfaces pressed tightly).

- Change the paper every 6-8 hours to avoid fungal attack and repress the specimen.
- Repeat the operation till specimens become dry.
- Paste the specimen on a herbarium sheet available in the market.
- Note down the following on the prepared sheet either below the specimen or wherever there is sufficient uncovered space :
  - (a) Common name
  - (b) Botanical name
  - (c) Local name
  - (d) Growth behaviour
  - (e) Date of collection
  - (f) Site of collection

1c.4 Observations :

The pupil should see the herbarium already developed by the senior students or by the teachers concerned.

1c.5 Expected behavioural outcome :

The pupil acquires the follow abilities:

	Grade
i. Ability to select representative specimens of weeds.	
ii. Ability to dry the specimens.	
iii. Ability to paste the specimens	
iv. Ability to collect requisite informations for each specimen.	

The teacher should evaluate the pupil for the above abilities.

1c. 6. Questions:

i. How herbarium preparation is useful for the pupil?

ii. Why complete drying of weeds is essential before its actual pasting in the herbarium?

2. Activity Unit : DESCRIPTION OF THE IMPORTANT WEEDS OF MAJOR CROPS OF THE AREA

2.1 Instructional Objectives :

The pupil should be able to :

- identify the weeds of a particular crop
- describe the weeds associated with the crop
- know the methods of propagation of crop specific weeds.

2.2 Relevant information :

- Important weeds of major crops :

Wheat crop :

i) Lambsquarters (*Chenopodium Spp*).

ii) Fumitory (*Fumaria officinalis*).

iii) Wild safflower (*Carthamus oxyacantha*)

iv) Vetches (*Vicia* Spp)

v) Scarlet Pimpernal (*Anagallis arvensis*)

vi) Wild oat (*Avena fatua*)

vii) Littleseed Canarygrass (*Phalaris minor*)

viii) Perennial sowthistle (*Sonchus arvensis*)

Paddy crop :

i) Barnyardgrass (*Echinochloa* Spp.) most important in upland rice fields.

ii) Water hyacinth (*Eichhornia crassipes*)

iii) Duck salad

iv) Red stem

v) Salvinia (*Salvinia auriculata*)

vi) Pistia

vii) Swamp morning Glory (*Ipomoea aquatica*)

viii) Algae (*Phytoplankton*, *Filamentous* and higher algae like *Chara* Spp. and *Nitella* Spp.)

Maize crop:

i) Purslanes (*Portulaca* Spp.)

ii) Bindweeds (*Convolvulus* Spp.)

iii) Morningglory (*Ipomoea* Spp.)

iv) Nut sedge (*Cyperus rotundus*)

v) Witchweed (*Striga* Spp.)

vi) Johnsongrass (*Sorghum halepense*)

vii) Bermuda grass (*Cynodon dactylon*)

viii) Carpetweed (*Trianthema* Spp.)

(Note: Similar weeds are found in sorghum also)

Pearl millet (Bajra)

i) Helitrope (*Heliotropium* Spp.)

ii) Puncturevine (*Tribulus terrestris*)

iii) Sandbur (*Cenchrus* Spp.)

iv) Tephrosia (*Tephrosia purpurea*)

v) Crotolaria (*Crotolaria burhia*)

vi) *Indigofera trigonelloides*

vii) *Pulicaria wightiana*

viii) *Volutarella ramosa*

ix) *Aerva tomentosa*

(The list is not exhaustive. The pupils should identify common weeds of the area with the help of the teacher)

Description of crop-specific weed :

There are some special weeds which are specific to a crop. These cause great loss to the yield and quality of farm produce. For example : wild oat (Avena fatua) infests mainly winter grains like wheat, barley and oats. Little seedcanarygrass (Phalaris minor) is specific to wheat crop, wild safflower (Carthamus Oxyacantha) is chiefly associated with winter grain crops. Witchweed (Striga spp.) is a common parasitic weed in pearl millet, sorghum, sugarcane, maize, rape and mustrad. Some crops like tobacco, brinjal, tomatoes are host plants to broomrape (Orobanche spp.). There are several such examples. The pupil with the help of teacher should identify such weeds and then show the life cycle of these weeds with the help of herbarium, charts, slides etc. One such example is given below as an illustration:-

Striga spp. :-

Distribution:- Andhra Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, Tamil Nadu and Punjab.

Biology - Common species of Striga:

a) Striga asiatica
b) S. lutea
c) S. hirsuta

These are all annuals, parasitic herbs, propagate from seeds. Germination of striga seeds requires stimulus from root exudates of specific host plants continuously for 24 - 48 hours. Heavy rain, application of irrigation water or heavy rates of nitrogen fertilizers during this period dilute the stimulus which may reduce the germination of striga.

Host plants are pearlmillet, sorghum, maize, sugarcane and rape and mustrad. Upon germination, striga seeds produce 2-3 mm long radicles. They form haustoria on nearly host roots as shown in Fig. 2.2.1

They continue extending their growth involving the whole root system of crop plants sucking water and nutrients from them. The affected crops look drought struck despite adequate soil moisture. After about 20 days life as a total parasite, striga emerges through the soil as green plants. Now it becomes partial parasite, making its own carbohydrates.

Each striga plant may produce over a million seeds after about 30 days of its emergence.

2.3 Materials required

i. Live specimen of weeds collected from a particular crop field like wheat, maize, paddy, sooghum, sugarcane, cotton etc.

ii. Charts and slides

iii. Herbarium

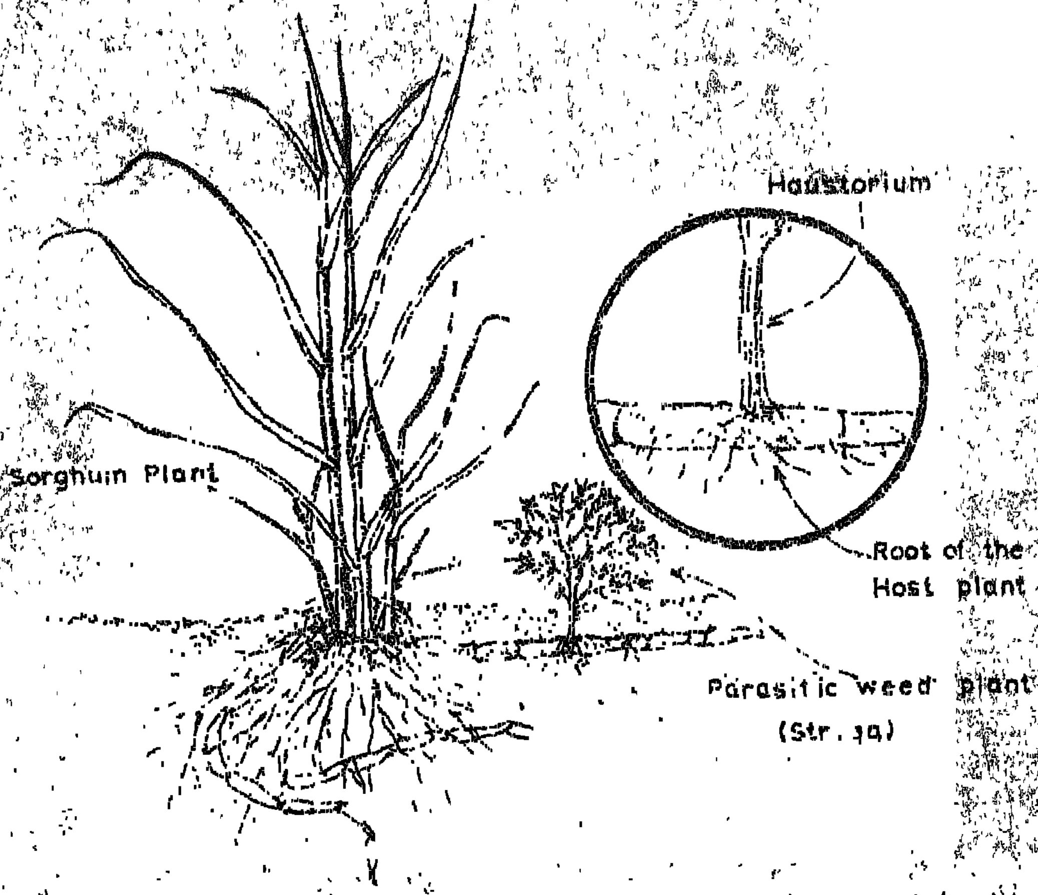

Fig. 12.2.1: A parasitic weed (Striga) drawing nutrients through haustoria from the roots of sarghum plant

2.4 Procedure

- Visit the farms and collect weeds crop-wise
- List the weeds
- Study the weeds with regard to method of propagation, stage of growth and the habitat.

2.5 Observations:

The pupil should record their observations in the following formats.

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Crop	Name of the weeds identified	Method of propagation	Stage of growth (Characters of weed)
	i.		
	ii.		
	iii.		

Crop	Weeds taxonomically not yet identified	Method of propagation	Stage of Growth (characters of weed)
	i.		
	ii.		
	iii.		

Name of parasitic weeds, if observed
i.
ii.
iii.

2.6 Expected behavioural outcome :

The pupil acquires the following abilities

Grade

i. Ability to identify weeds.

ii. Ability to relate weeds with crops.

iii. Knows important characters of weeds.

iv. Ability to differentiate between mono & dicotyledonous weeds.

v. Knows about the method of propagation of the weeds collected.

vi. Ability to identify parasitic weeds.

The teacher should evaluate the pupil for the above abilities.

2.7 Questions :

i. Fill in the blanks.

a)................... is a mono-cotyledonous weed found in wheat field.

b)................... is a dicotyledonous weet found in paddy field.

c)................... is a parasitic weed found in Bajra field.

d)................... is one of the most common weeds of the wheat field.

e)................... is a mono-cotyledonous weed found in paddy field.

ii. Name five mono-cot ylcdpnous weeds.

iii. Name five leguminous weeds.

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3. Activity Unit : DESCRIPTION OF WEEDS OF WATER BODIES AND NON-CROPPED AREAS

3.1 Instructional Objectives :

The pupil should be able to :

- appreciate weed control in water bodies
- identify weeds growing in water bodies like irrigation canals, channels, ponds, lakes etc.
- identify weeds growing on road, barren lands, edges of the fields, industrial sites etc.
- describe weeds.

3.2 Relevant information :

- Weed Control in water bodies, why?
  - Not only on land, weeds are nuisance in water-bodies also.
  - Aquatic weeds change the flavour, apperance and taste of water.
  - They render swimming, boating and other recreation unappealing.
  - They jam traffic through canal, rivers and large lakes.
  - Flow of canals is reduced considerably when submerged weeds infest them.
  - Drainage and irrigation channels are clogged down by aquatic weeds which results into seepage and water-logging around the ditches.
  - There is great water loss through transpiration by aquatic weeds.

- Aquatic weeds are menace to fisheries.
- In addition to being unseemly, weeds and bushes on industrial sites are a potential source of fires.
- They deteriorate the stores, equipment, materials and impair man's working efficiency.
- Obstruct road signs and visibility at crossing and curves.
- They hide industrial pipe lines and valves on the ground.
- Encroachment reduces road width and weaken asphaltic surfaces.
- On railway tracks weeds weaken the rails and increase chances for accidents.
- They are public nuisance.
- They are source for weed infestation in the fields.

-- Important weeds of water bodies, ditches, canals, ponds, lakes, railway tracks, industrial sites etc.

- Aquatic weeds :

  A. Algae

    i) Phytoplankton

       Anabaena Spp.

    ii) Filamentous algae

       Cladophora Spp.

    iii) Higher algae

       Chara Spp. (Muskgrass)

B. Vascular acquatic weeds

i) *Alternanthera philoxeroides* (alligator weed)

ii) *Azolla pinnata* (azolla form)

iii) *Cladium* Spp. (sawgrass)

iv) *Eichhornia crassipes* (waterhyacinth)

v) *Ipomoea aquatica* (morning glory)

vi) *Lemna minor* (duck weed)

vii) *Nelumbo nucifera* (lotus)

viii) *Nymphaea stellata* (waterlily)

ix) *Typha augustata* (narrow leaf cattail)

x) *Typha latifolia* (common cattail)

xi) *Utricularia flexuosa* (bladderwort)

xii) *Zannichellia palustris* (horned pond weed)

- Weeds of uncropped area :

i) *Ipomoea* Spp

ii) *Lantana camera* (Lantana)

iii) *Convolvulus arvensis* (Field bindweed)

iv) *Saccharum spontaneum* (Tigergrass)

v) *Sorghum halepense* (Johnsongrass)

vi) *Tribulus terrestris* (Puncturevine)

vii) *Acasia* Spp. (Acasia)

viii) *Argemone mexicana* (Mexican prickly poppy)

ix) *Cannabis sativa* (Hemp)

x) *Cynodon dactylon* (Bermuda grass)

xi) *Opuntia dilleni* (Prickly pear)

xii) *Portulaca oleracea* (Common purslane)

xiii) *Tephrosia purpurea* (Tephrosia)

xiv) *Trianthema monogyna* (Carpet weed)

xv) *Xanthrium strumarium* (Cocklebur)

3.3 Precautions :

- Before entering into any water body for collection of weeds, the depth of the water body should be determined.
- While collecting weed samples care should be taken that each sample bears maximum characters for identification.

3.4 Materials required :

i. Specimens of weeds collected from the water bodies and uncropped areas.

ii. Diagrams and charts of aquatic and other weeds of uncropped areas.

3.5 Procedure :

- Visit canals, ponds, lakes, industrial sites, railway tracks etc. to collect weed samples.
- Identify the collected weeds.
- Study morphological and other characters of the collected weeds.
- Examine water of the water bodies for colour, odour and taste.
- Find out the number of various types of weeds, separately for each water body.

3.6 Observations :

The pupil should record the information in the following tables :

Name of the place from where the samples are collected	Name of the Weed	Important characters and stage of the growth of the weed
1.	i. ii. iii. iv.	

Name of the water body/ uncropped area visited	Colour of the water	Odour of the water	Taste of the water
i.			
ii.			
iii.			
iv.			
v.			

3.7 Expected behavioural outcome :

The pupil acquires the following abilities:

	Grade
i. Awareness about the weeds of water bodies/uncropped area.	
ii. Ability to identify weeds of water bodies/uncropped area.	
iii. Knowledge about the harmful effects of weeds on water bodies	

The teacher should evaluate the pupil for the above abilities.

3.8 Questions :

1. How aquatic weeds change the quality of water?

2. How aquatic weeds affect fish growth?

3. Why weeds in uncropped areas like industrial sites are fire hazard?

4. How weeds disrupt communication and traffic systems?

4. Activity Unit : STUDY OF PROPAGATION BEHAVIOUR IN WEEDS

4.1 Instructional Objectives :

The pupil should be able to

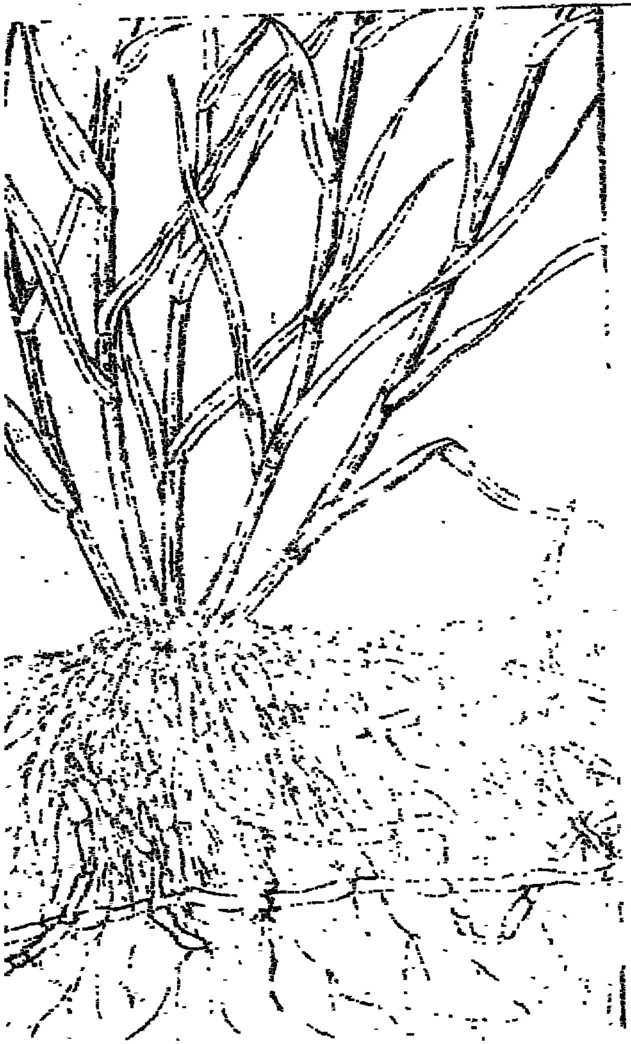
- identify weed seeds, rizhomes, root stocks, stolons, tubers, bulbs, bulbils, stems and roots
- study various appendages which help weeds for their wider dissemination.
- count number of weed seeds per plant.
- collect weed seeds from air, water bodies, men and animals.
- undertake study of root system of nut sedge.
- acquire knowledge with regards to methods of propagation and agents of weed seed dispersion.

4.2 Relevant information :

- How weeds are propagated ?

a) Sexual & Asexual : In sexual reproduction fusion of two reproductive cells takes place. Where'as in asexual reproduction, union of two organs does not take place, instead each reproductive cell is cut off from the parents and it grows into a new plant by spore formation or fission. This type of reproduction is common in algae and ferns.

b) Vegetative : In this a small portion of mother plant is either cut or detached and it grows into a separate plant. For example rhizomes (Fig.4.2.1)



4.2.1: Rhizomes of Sorghum helepense

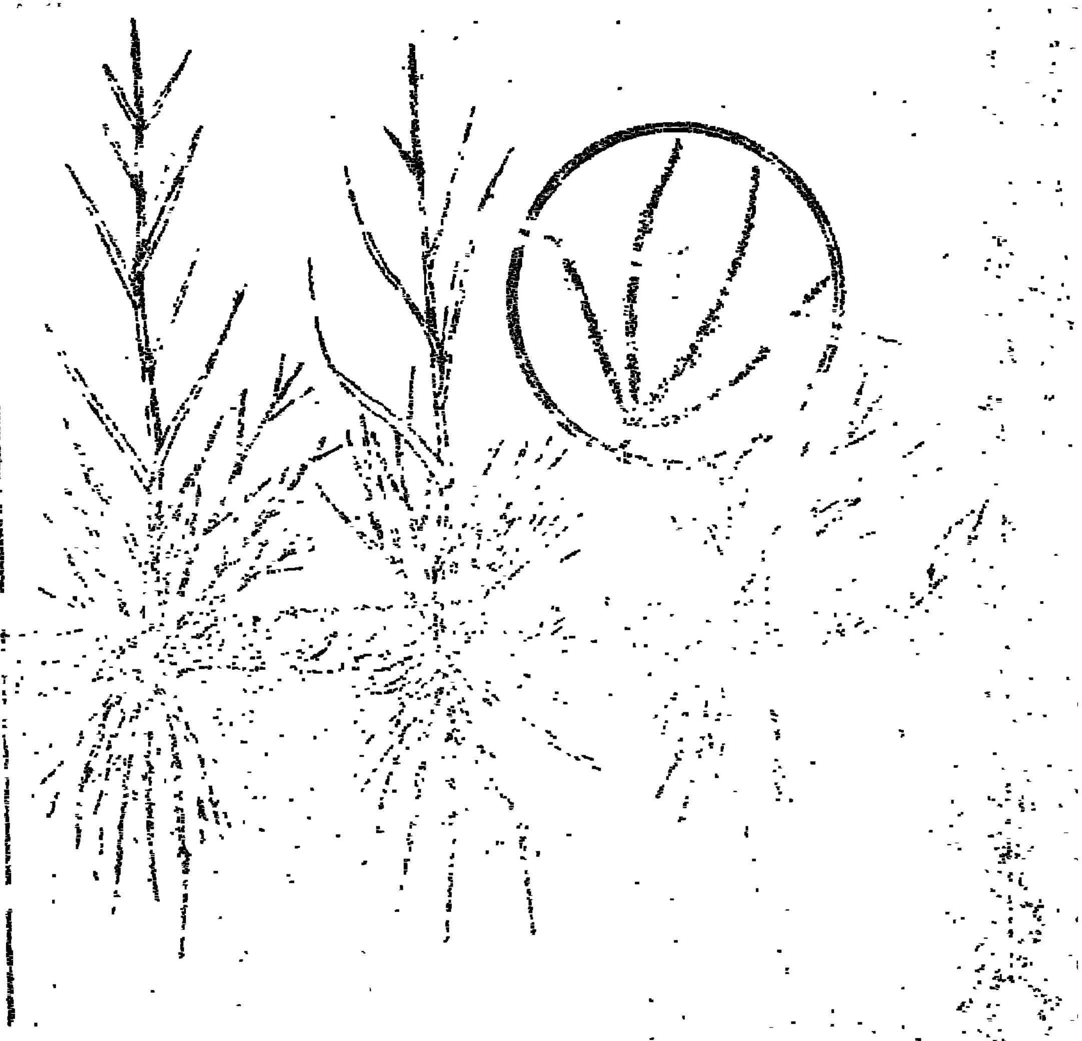


Fig. 4.2.2: Runners of Cynodon dactylon

and root stocks, runners (Fig.4.2.2), stolons, suckers, tubers, offsets, bulbs, bulbils, stems and roots.

- How weeds are distributed ?

There are various ways through which weed seeds get distributed. These are as under :

a) Natural seeding and by the wind.

b) Farm yard manure.

c) Admixtures in seeds.

d) Farm machinary and Implements.

e) Broken pieces of roots and rhizomes.

f) Birds and animals

g) Man

h) Water.

- Why to study propagation behaviour of weeds ?

Asound knowledge of the mode of propagation and dispersal of weeds is essential for effective prevention and control of weeds. Without proper understanding about propagation behaviour of weeds they can only be checked temporarily.

- Appendages :

These are defined as specific organs that keep weed seeds and fruits afloat during dissemination of weed seeds through wind (Fig. 4.2.3). Some of these organs are called as under :

a) Pappus

b) Comose

c) Persistent style

d) Baloom

e) Wings.

4.3 Precautions :

- Collection of weed seeds should be done carefully and it should be free from admixtures.

4.4 Materials required :

i. Weed seeds, rhizomes, root stocks, stolons, tubers, bulbs, bulbils, stems and roots.

ii. Illustrations of weed seed.

iii. Charts and photoes to show dissemination of weeds through wind, water, man and animals.

iv. Charts to show various appendages on weed seeds which assist them in dispersal.

v. Spade and Khurpi

vi. Paper bags

vii. Containers like Dalda tins for collecting water samples.

viii. Cloth for straining the water.

This activity Unit should be completed through the following sub-units:

- study of number of seeds per plant.
- study of weed seeds collected from air.
- study of weed seeds collected from water bodies.

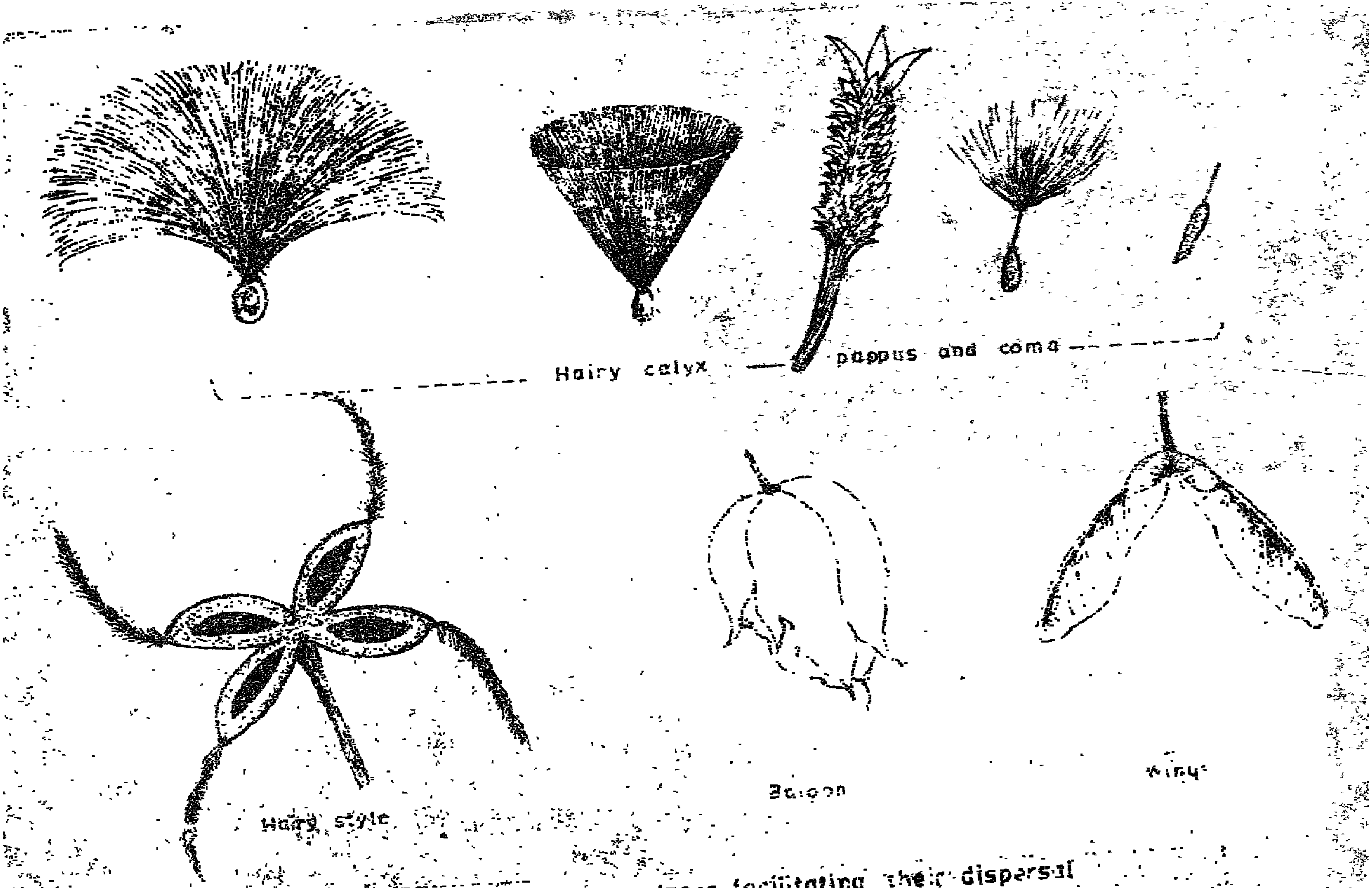


Fig.4.2.3: Seed appendages facilitating their dispersal

- study of weed seeds collected from men and animals.
- study of root system of nut sedge.

4a. Sub-unit : STUDY OF NUMBER OF SEEDS PER PLANT:

4a.1 Relevant information:

- Seed production capacity of certain common weeds :

Weed	Average no. of seeds per plant
Amaranthus spp	196,000
Chenopodium album	72,000
Commelina benghalensis	2,450
Eleusine indica	41,200
Physalis angulata	22,000
Trianthema spp.	52,000

4a.2 Procedure :

- Make field visits and collect matured seeds of individual plant in paper bags.
- Label each bag indicating date, place and name of the weed plant.

4a.3 Observations :

The pupil should record the following informations in the table given below :

Name of the weed	Number of weedseed/Plant	Description of the seed (size, shape, colour)

4b. Sub Unit : STUDY OF WEED SEEDS COLLECTED FROM AIR

4b.1 Procedure :

- Make field visits and collect weed seeds floating in the air. This may not be possible always but should be tridd.

4b.2 Observations :

The pupil should record the following information in the table given below :

Name of the weed	Characters of seed collected

4c. Sub-unit : STUDY OF WEED SEEDS COLLECTED FROM WATER BODIES

4c.1 Procedure :

- Make field visits and collect samples of water from canals, irrigation channels, ponds in seperate containers.
- Strain the water through fine cloth.
- Dry the cloth in the sun.
- Collect the material.
- Inspect if there are some seeds.

4c.2 Observations :

The pupil should record the following informations in the table given below :

Name of weed	Characters of weed seeds

4d. Sub-unit : STUDY OF WEED SEEDS COLLECTED FROM MEN AND ANIMALS

4d.1 Procedure :

- Inspect the sole of the shoes of many farm workers and collect the adhering soil samples to study week seeds (Fig. 4d.1.1) in the soil. Store the sample in separate bag and label it. Similarly inspect some farm animals and collect week seeds from their hoof and body in separate bags and label them.
- Dry the sollected soil samples.
- Place the soil in a shallow container and water it lightly.
- Leave it for a weed or so for the seeds, if any to germinate.
- After a weed observe germination of weed seeds and if possible identify the weeds.

4d.2 Observations :

The pupil should record the following information in the table given below:

Name of the weed	Characters	Source (Man/Animal)

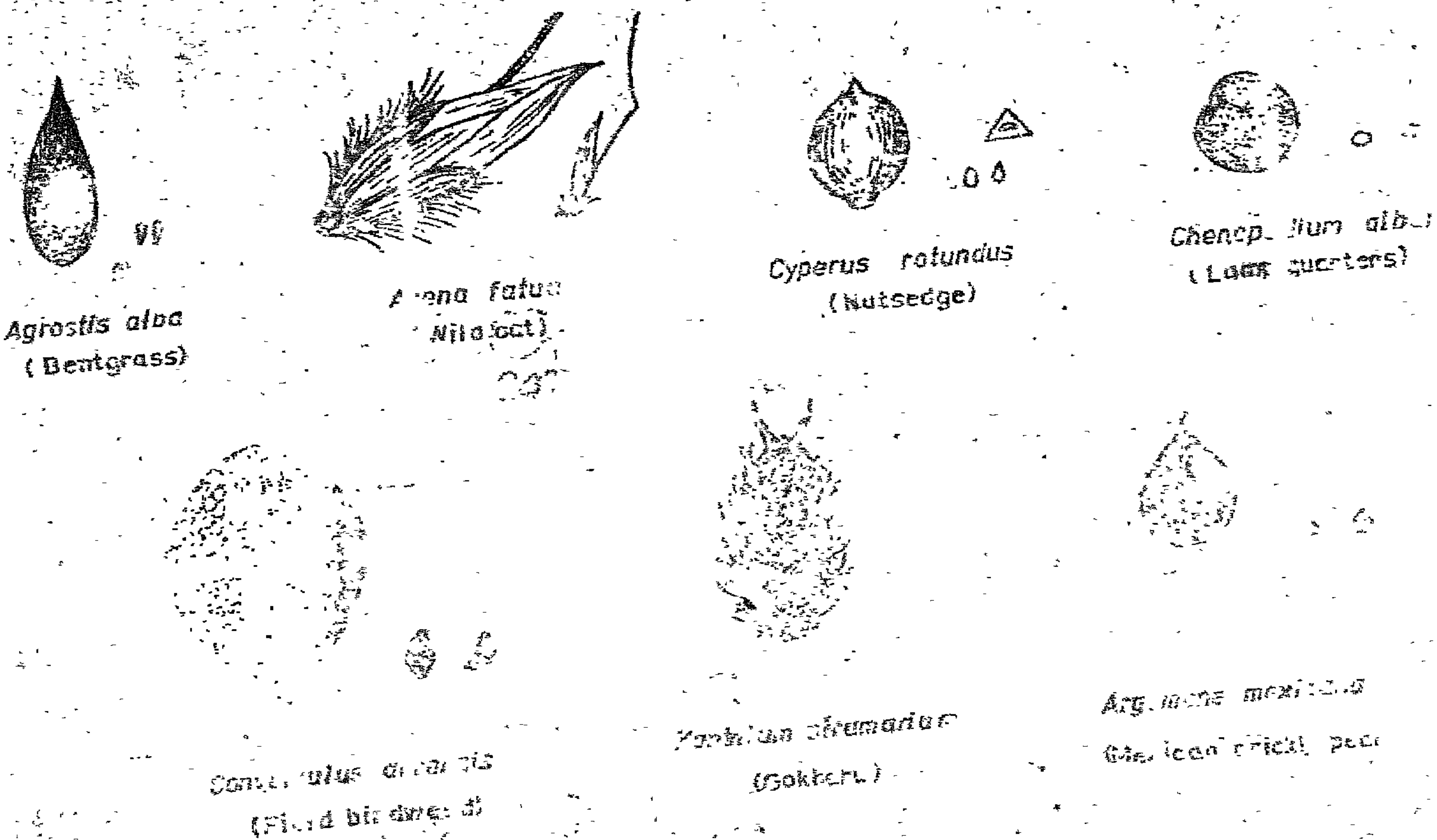


Fig. 4d.1.1: Seeds of some common weeds

4e. Sub-unit : STUDY OF ROOT SYSTEM OF NUTSEDGE

4e.1 Procedure :

- Make field visits and select a spot where there is good growth of nutsedge (fig.4e.1.1)
- Select one or two nutsedge plants.
- Carefully dig the surrounding of the nutsedge plant.
- Undertake finer digging with the help of khurpi.
- If soil is hard, use water to loose it and to avoid cutting of roots.

4e.2 Observations :

The pupil should record the following observations.

i. Depth upto which root system observed (in metres) =.. ....m.

ii. Type of soil.....................................

iii. Number of tubers on one plant =...............

iv. Note characters of the tuber.

v. Draw a diagram of the profile.

4.5 Expected behavioural outcome :

The pupil acquires the following abilities.

	Grade
i. Ability to identify those weeds which are most prolific seeder.	
ii. Ability to count the weed seeds.	
iii. Ability to identify weeds on the basis of the shape, size & colour of the seeds.	
iv. Ability to identify the weeds on the basis of source of propagation.	
v. Ability to study root system of nutsedge plant.	
vi. Knowledge about the methods of propagation for most of the common weeds.	

The teacher should evaluate the pupil for the above abilities.

4.6 Questions :

i. Why study of propagation behaviour of weeds is essential?

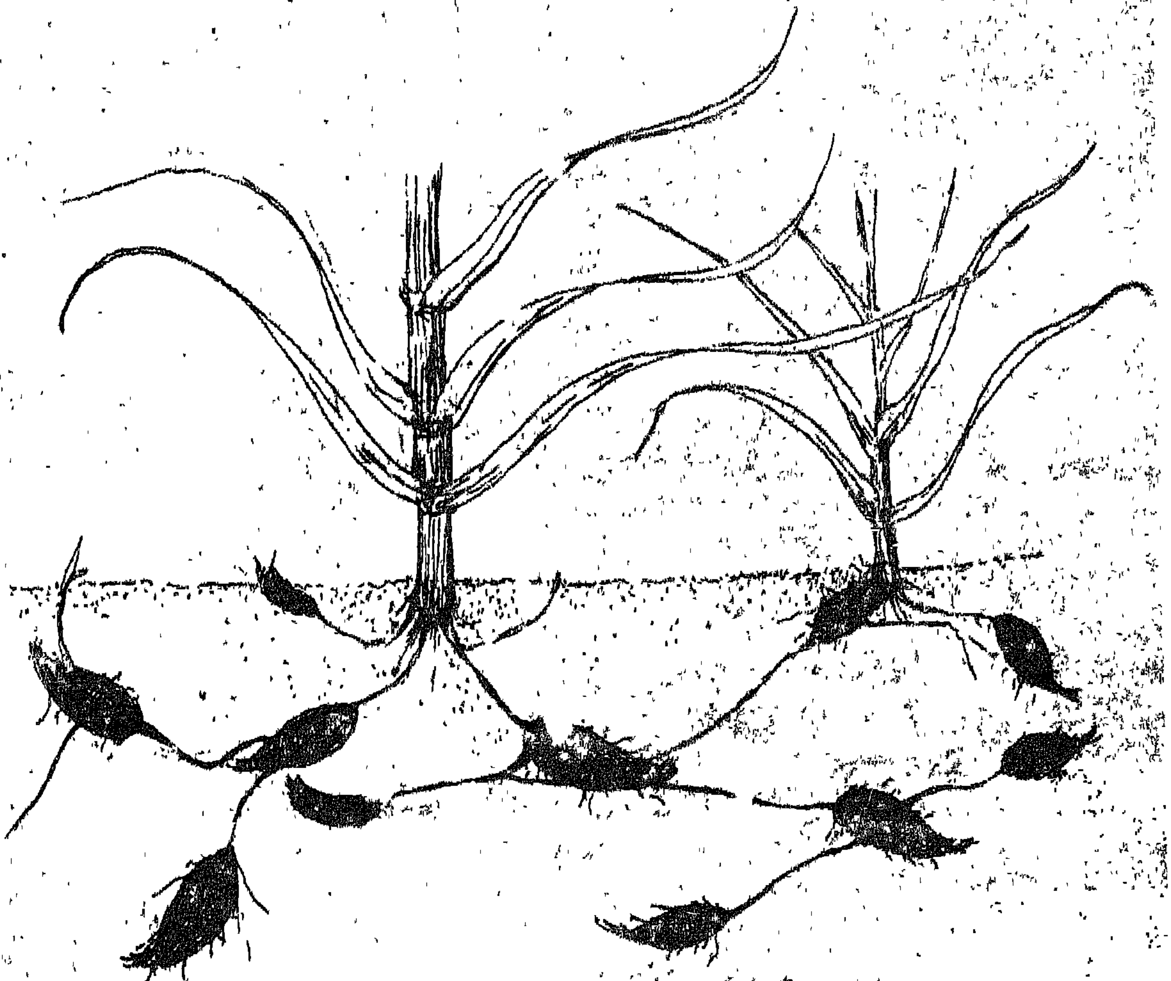


Fig. 4e.1.1; Root system of Nutsedge plant

ii. What are different carriers of weed seeds and which is the most common?

iii. What are appendages?

iv. Why nutsedge is a difficult weed to control?

v. Name five weed plants which produce more than 50,000 seeds per plant?

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5. Activity Unit : DETERMINATION OF INTENSITY OF WEED INFESTATION IN THE FIELD

5.1 Instructional Objectives :

The pupil should be able to

- know the extent of crop-weed competition in critical stage of crop growth.
- find out the number and nature of mono and dicotyledonous weeds competing with the crop.
- calculate the ratio between the crop and weeds.
- know the major weeds most commonly competing with the crop.

5.2 Relevant information :

- Relation between intensity of weeds & crop growth :

It is known fact that increased weed intensity in the crop field, results in reducing growth and yield of crops within limits. The relationship is usually observed as given in Fig.5.2.1

In Fig.5.2.1 it can be seen that there is a minimum weed density required to suppress crop growth and yield and at the same time beyond certain high weed density, crop growth and yield is reduced in proportion to the weed growth. Zero weed growth is often too costly and unnecessary to aim at.

The competition for moisture, light, space and nutrients between crop plants and weeds is

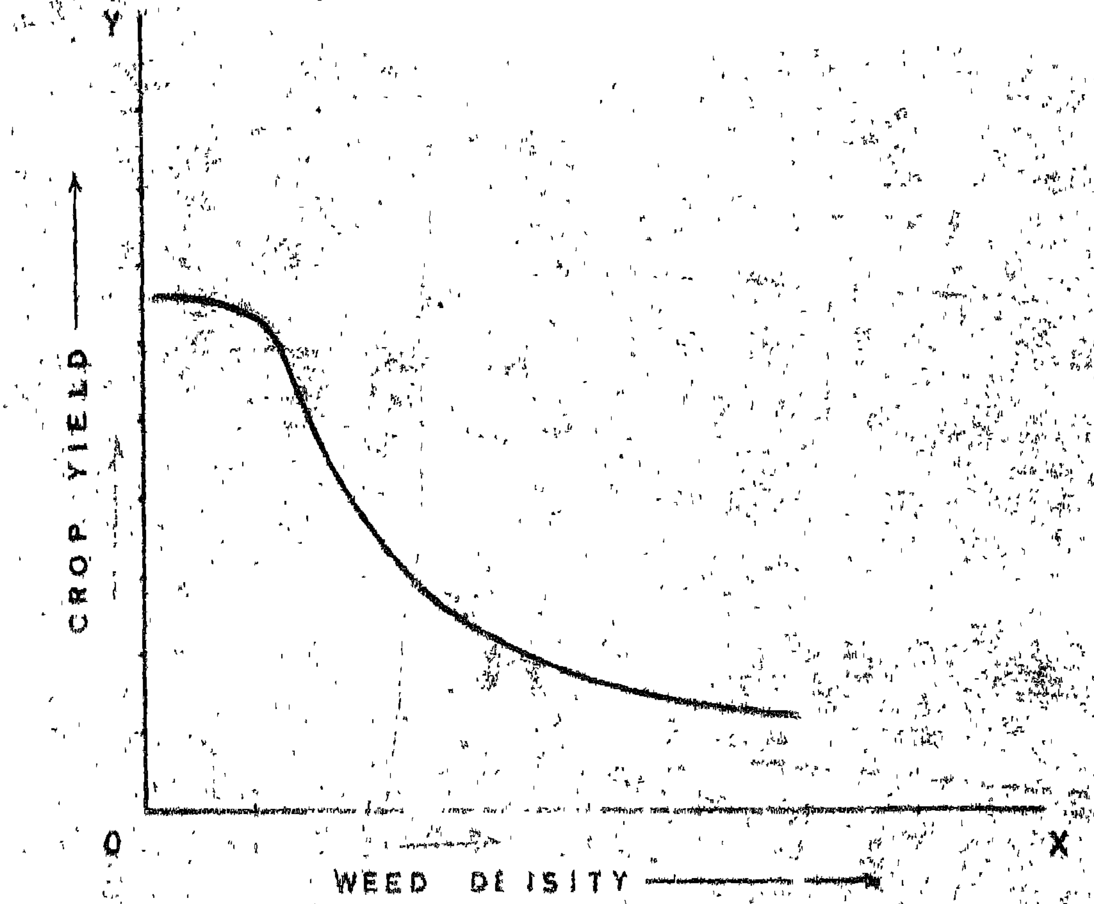

Fig. 5.2.1 Relationship between intensity of weed growth and crop growth

not uniform through out the growth period of the crop. The compeitition is invariably severe in early stages of crop than in later stages. It is enough to control the weeds in first one-third life period of most of the crop.

- Need to measure weed density :

It is necessary to know the number and nature of weeds competing with the crops. The weed density gives the biological stress that the crops are subjected to.

It is easy to measure weed density during earlier stages or critical period of crop-weed competition.

- Measurement of weed density :

There are two methods normally adopted for the measurement of weed density :

i. Counting method: Here different species of weeds are counted by using the Quadrate in a crop field.

ii. Dry matter weight : By this method, the weeds are cut at the base and the fresh weight, immediately and the dry weight, after drying in an oven are, taken to know the weed density.

5.3 Precautions :

The weed count should be taken after the emergence of weeds but at the initial stage of crop growth itself to facilitate the placement of quadrate.

Take care to note the name and number of weeds immediately.

Select at random, the location or site for placing quadrate in different places of the crop field.

5.4 Materials required :

i) Quadrate of 0.5m x 0.5m size
ii) Observation note book
iii) Pencil

5.5 Procedure :

- Select a field with young crop plants and weeds for taking weed count.
- Place the Quadrate at randomly selected place in the field.
- First pull out all the dicotyledomous weeds inside the Quadrate taking simultaneous counting.
- Record the number of dicotyledonous weeds in the observation note. (If possible, counting may be done for individual species of weeds).
- Then pull out and count all the monocotyledenous weeds. Record it.
- Count the crop plants inside the Quardrate.
- Place the Quadrate at different places in fields selected randomly and count the dicotyledonous weeds, monocot yledonous weeds and crop plants.
- Calculate the average value of weeds and crop plants.
- Multiply the number of monocotyledonous weeds by four to find out the number of weeds/sq.metre.
- Then multiply by 10,000 to find out the number of monocotyledonous weeds per hectare.
- In the same way, calculate the number of dicotyledonous weeds/ha.and crop plants/ha.

5.6 Observations :

The pupil should record the information in the table given below:

Site of placement of quadrate	Number of monocot. weeds per 0.25 sq.m.	Number of dicot. weeds per 0.25 sq.m.	Number of crop plants per 0.25 sq.m.	Name of major weeds
I.				i. ii. iii. iv. v.
II.				
III.				
IV.				

5.7 Calculations :

On the basis of the above observations the pupil should calculate the followings:

i. Area of the quadrate = 0.5 x 0.5 = 0.25m

ii. Number of monocot. weeds/sq.m. =

iii. Number of dicot. weed/sq.m. =

iv. Number of crop plants/sq.m. =

v. The percentage of monocot. weeds =

vi. The percentage of dicot. weeds =

vii. Ratio between crop and weeds =

viii. Number of dioct. weeds/ha. =

ix. Number of dicot. weeds/ha. =

x. Number of crop plants/ha. =

5.8 Expected behavioural outcome :

The pupil acquires the following abilities:

Grade

i. Ability to count the weeds.

ii. Ability to calculate the weeds on per ha. basis.

iii. Knowledge about the relationship between weed infestation and crop growth

The teacher should evaluate the pupil for the above abilities.

5.9 Questions :

i. What is weed density ?

ii. How can you make use of data on weed density?

iii. Which of the following methods is better to estimate weed infestation of the field? Explain the reasons.

a) Weed count.

b) Weed weight (dry matter)

6. Activity Unit : WEED CONTROL THROUGH GOOD CROP HUSBENDARY

6.1 Instructional Objectives :

The pupil should be able to:

- recognise the relationship between different cultural practices and weed control.
- develop insight into manipulating the various operations in a manner non-conducive to weed growth.
- differentiate between classes of weeds which need different management practices for effective control.
- assess the economics of the practices by comparing yields of a weeded plot against that of an unweeded plot.
- find out possible economic uses of weeds removed from the field.

6.2 Relevant information

- Concept :

It is well known that weeds affect crop-yields considerably, if allowed to grow unchecked. They also spoil surrounding and create problems in channels, on bunds, roads etc. Chemical method of weed control is yet not very popular for two reasons - firstly because of its sophestication coupled with need for safety precautions against health and environment hazards, secondly because of the cost factor. But good crop-husbandry has been an age-old aid, which if used judiciously, gives considerable control over weeds.

It is within traditional work habits and less costly for a farmer, as human labour supplemented by bullock power is plent in the country.

- Agronomic practices in relation to weed control :

  i. Crop stimulation

  ii. Staggered planting time

  iii. Variation in planting spaces

  iv. Crop rotation inconvenient toweeds

  v. Summer fallowing

  vi. Tillage operations

  vii. Irrigation (flooding) and others.

6.3 Precautions :

- This is a time consuming activity, hence observations from time to time may be taken from the plots.

6.4 Materials required :

All the materials essential for raising a good crop (Wheat, Paddy & Maize)

6.5 Procedure :

- Raise a field crop by following different agronomic practices (as mentioned in 6.2) in small plots preferrably of 2x2 in size. Keep one unweeded plot following traditional practices as control.

6.6 Observations :

The pupil should record the followings :

A) Weed behaviour as affected by various crop husbandry practices.

B) Identification of weeds for their possible use after removal.

A) For weed behaviour record the information in the table given below. Indicate the agronomic practice and plot number.

a) Agronomic practice...(plot No............)

Date of Observation	Interval from the previous observations	Weeds found			stand of the crop		
		kinds	population	stage	Name	population	stage

Besides above, collect & record the following information:

i. Ultimate yield of the crop in the sub-plot ....

ii. Ultimate yield of the crop in the control sub-plot.................

iii. Value of the crop produce in sub plot (i) ....

iv. Value of the crop produce in control sub plot (ii).................

b) Agronomic practice.............;.......................(plot No..........)

Date of Observation	Interval from the Previous observations	Weeds found			Stand of the crop		
		kinds	population	stage	Name	population	stage

Besides above, collect & record the following information :

i. Ultimate yield of the crop in the sub-plot...........................

ii. Ultimate yield of the crop in the control sub-plot,...................

iii. Value of the crop produce in sub-plot (i).........................

iv. Value of the crop produce in control sub-plot (ii)....................

c) Agronomic practice...(plot No..........)

Date of observation	Interval from the previous observations	Weeds found			stand of the crop		
		kinds	population	stage	Name	population	stage

Besides above, collect & record the following information :

i. Ultimate yield of the crop in the sub-plot..............................

ii. Ultimate yield of the crop in the control sub-plot.......................

iii. Value of the crop produce in sub-plot (i)...............................

iv. Value of the crop produce in control sub-plot (ii).......................

Conclusions & Recommendations

On the basis of the above observations the pupil should conclude and give his/her recommendations for the type of agronomic practice to get maximum profit.

a)

b)

c)

B) The pupil should also identify weeds for their possible use after removal and same may be recorded in the following table:

USE	NAME OF WEEDS	SPECIAL NOTES
Green manure		
Compost		
Animal fodder		
Human food		
Medicine		
Narcotics		
Subsidiary fuel		
Thatching		
Any other		

6.7 Expected behavioural outcome :

The pupil acquires the following abilities

	Grade
i. Knowledge about various agronomic practices to control weeds.	
ii. Performance of actual agronomic practices to control weeds	
iii. Ability to find out appropriate agronomic practice based on returns	
iv. Identification of weeds for their possible uses after removal	

The teacher should evaluate the pupil for the above abilities.

6.8 Questions :

i. Explain each one of the agronomic practices in the light of weed control.

ii. Name five weeds which can be used as animal fodder.

iii. Which agronomic practice you consider as the most economical and why?

7. Activity Unit : STUDY OF HERBICIDE FORMULATIONS

7.1 Instructional Objectives :

The pupil should be able to :

- know the various formulations available.
- identify different herbicide formulations.
- prepare the spray suspension or solution.
- know the properties of different herbicide formulations.
- acquaint with the label information on commercial herbicides.
- explain the importance of label information to the user.
- select proper herbicides.
- work out the correct quantity of a formulation equivalent to the recommended dose of herbicide.
- study wettable powders and emulsifiable liquid concentrates of formulations.
- calibrate sprayers.

7.2 Relevant information :

- Types of formulations :

Most herbicide molecules are directly not in a form suitable for their field application for weed control. These must be formulated by addition of suitable adjuvants to improve their solubility in water, their application feasibility, their leaf surface-activity, storage life, safety to the users, etc. These formulations can be either in the form of Emulifiable concentrates (EC), Wettable powders (W.P.), Soluble powders (S.P.) or soluble liquid concentrates (S.C.). More recently herbicides are formulated as granules also (G). Brief description of various types of formulations is given below :

- Emulsifiable concentrate (E.C.) :

It is a product of the active ingredient (Technical material), a solvent and an emulsifier. As active ingradients are not soluble in water, it is prepared by dissolving the a.i. in a small quantity of soluble solvent and emulsifying it in water to the required degree of concentration, e.g. Stam F-34 36% EC and 2,4-D ester.

- Wettable Powders (W.P.)

Herbicide materials of low solubility may be milled into fine powder and suspended in water. Wettable powders require continuous agitations to prevent their settling and to give a uniform level of chemical in the spray e.g. DCPA, and Atrazine 80% W.P.

- Soluble Powders (S.P.)

Can be dissolved in convenient amounts of water and sprayed efficiently. Salts of most herbicides are soluble in water e.g. Dalapon.

- Soluble concentrate (S.C.)

erbicides which are available in the form of soluble liquids and can be easily added to water, e.g. Dicamba (Banvel) and 2,4-D amine.

- Granules (G.)

The granules are small pellets formed from various inert clays and sprayed with a solution of the toxicant to give the desired content. After the solvent has evaporated, the granules are packaged for use, e.g. Machete granules.

Some of the important terms used in herbicides are as under :

- Technical grade material :

The herbicide in its relatively pure form.

- Formulation :

The form in which the herbicide is sold for use or the usable form of herbicide.

- Need for a formulation :

Herbicides are formulated to improve their storage, handling, application, effectiveness and safety properties.

- Liquid formulations :

i. Aqueous solutions (soluble concentrates) (SC)

ii. Emulsifiable liquid concentrate (EC)

- Emulsion :

It is a combination of two liquids held together by a third chemical called emulsifier. They are usually (i) oil in water (O/W) and (ii) water in oil (W/O)

- Dry formulations :
  - i. Soluble powders (S.P.)
  - ii. Wettable powders (W.P.)
  - iii. Granules (G.).

- Advantages of granules over sprays :
  - i. Water is not needed to apply the material.
  - ii. Costlier spray equipment is not required since they are applied directly by hand or with simple distributors.
  - iii. Granules (larger in size) have very low drift hazard potential than the spray.
  - iv. They tend to fall off the leaves of crop without injury.

- Disadvantages of granules :
  - i. They are heavier and more bulky and transport charge may increase the cost considerably.
  - ii. Application may not be uniform.
  - iii. Granular herbicides require more soil moisture to activate them than spray liquids.
  - iv. They are not adapted for foliage treatment.

This activity unit has been divided into four sub-units for proper understanding and actual doing. These sub-units are :

a) study of herbicide label information.

b) calculation involved in the use of different formulations of herbicides.

c. Comparative study of WP and EC formulations.

d. Calibration of a sprayer.

7a. Sub Unit : STUDY OF HERBICIDE-LABEL INFORMATION

7a.1 Relevant information :

Significance of symbols on the label :

Several signal words or symbols based on the toxicity of the product are required by law to group them into respective categories of toxicity. There are 4 categories of toxicity and each of which is indicated by an appropriate symbol and signal as follows :

	Toxicity category	Acute oral toxicity LD 50 mg/kg	Colour of Triangle	Signal Word required on label	Warning Symbol on the label
I.	Extremely Toxic	0-50	Bright Red	Word "POISON" printed in Red	Skull and Cross bones
II.	Highly Toxic	51-500	Bright Yellow	Word "POISON" printed in Red	-
III.	Moderately Toxic	501-5000	Bright Blue	Word "Danger"	-
IV.	Slightly Toxic	5000	Bright Green	Word "Caution"	-

7a.2 Precautions

- Read all the informations given on the labels of the containers.
- Note the symbols written on the labels very carefully.

7a.3 Materials required :

i. Empty herbicide containers bearing labels.
ii. Sample labels of various types of commercial herbicides.

7a.4 Procedure :

- Examine a few commercial herbicide containers and make a list of all types of informations given on the labels.

7a.5 Observations :

The pupil should note down the information available on the labels against each item in the table given below.

ITEM	Herbicide			
	1	2	3	4
i. Chemical name				
ii. Common name				
iii. Trade name				
iv. Manufacturers address				
v. Percentage of active ingredient				
vi. Percentage of carrier, filler & adjuvants.				
vii. Difference between different products containing the same active ingredient.				

contd.....p.80

viii. Net content, if given

ix. Treatment for accidental exposure or poisoning.

x. Date of manufacture.

xi. Date of Expiry

xii. Misuse statement, if any.

xiii. Direction for use, if any.

xiv. Storage and disposal of the product, if any.

xv. Warranty statement, if any

contd......p. 81

xvi. Precautionary statements,
if any.

xvii. Name of the crops
for which the
herbicide is
recommended.

xviii. Any other information.

7a.6 Expected behavioural outcome :

The pupil acquires the following :

Grade

i. Ability to identify herbicides as per their formulations.

ii. Knowledge about various informations available on the lables of the containers

The teacher should evaluate the pupil for the above.

7a.7 Questions :

i. Why date of manufacture and date of expiry of a herbicide are given on a lable?

ii. Why use of expired herbicide is discouraged?

iii. All other factors being equal, should selection of herbicide be based on cost per unit of concentrated material purchased or on cost per unit of finished spray solution ready for use?

iv. Which colour of the triangle will indicate the extreme toxicity of the herbicide?

7b. Sub Unit : CALCULATION INVOLVED IN THE USE OF DIFFERENT FORMULATIONS OF HERBICIDES

7b.1 Relevant information:

- Need for the calculation of the commercial product:

The recommended dose of herbicide for different crops are always given in term of a.i. or a.e. Hence, one has to find out by calculation the correct quantity of herbicide formulations available in the market.

- Active ingredient :

It is that part of a chemical formulation which is directly responsible for the herbicidal effects. Active ingreidnet of such formulation is displayed by the manufacturer on herbicide formulation containers.

The active ingredient may be given as percent by weight or volume.

For example : A herbicide formulation marked 40% W/V contains 400 gm of active ingreident per litre of the liquid product. If you want to apply 1kg ai/ha of the herbicide through this product, one must use $\frac{100 \times 1}{40}$ or 2.5 litres of the material.

- Acid equalivent :

Acid equivalent refers to that part of a formulation that theoretically can be converted to the acid. In this case, the acid equivalent is given as the active ingredient.

For example, if the herbicide concentrate "Weedar -96" constituting dimethylamine salt as its active ingredient is specified on the label as a.e. 72% W/V. It means that each litre of 'Weedar-86' contain 720 gms. of parent 2,4-D, in the form of its amine salt.

Formula for the calculation of commercial product :

$$\frac{\text{Weight of the Chemical to be applied (a.i.)}}{\text{Percentage of active ingredient in the formulation.}} = \text{Weight of Commercial material required}$$

7b.2 Calculations :

In order to understand the calculations involved in determining the correct quantities of commercial herbicides, the pupil should solve a number of problems.

- Problem - i :

Calculate the amount of Tok E -25 emulsifiable liquid concentrate containing 250 mgs of nitrogen per litre for a pre-emergence application to wheat crop area of 0.25 ha when applied at the rate of 2.0 litres active ingredient per ha.

- Problem - ii :

Work out the correct quantity of Stam F-34 36% W/V EC required for the post-emergence application to 2.0 ha of paddy when applied at the rate of 2.5 litre a.i. propanil per ha.

- Problem - iii

An Atrazine herbicide formulation contains active ingredient of 80% WP. The desired rate of application for maize crop is 0.5 kg. ai/ha as pre-emergence application. Calculate the amount of herbicide formulation required for one ha area.

- Problem - iv :

You have a granuler material which is 10% active ODEC. You want to apply 8kg of active ODEC per hectare. How many Kg of commercial product per ha will you need?

- Problem v :

You want to apply ½ Kg active ingredient of diuren per ha to cotton. The label indicate that it contains 80% active ingredient. Calculate the amount of commercial products required per acre.

- Problem vi :

Calculate the amount of herbicide formulation required to apply in one ha. of sorghum at the rate of 0.4 Kg a.i./ha when an Atrazine formulation contains 80% W/V of active material?

7b.3 Expected behavioural outcome

The pupil acquires the following abilities

	Grade
i. Ability to calculate quantity of commercial herbicide required for an area.	
ii. Understanding of active ingredient and acid equivalent.	

The teacher should evaluate the pupil for the above abilities.

7b.4 Questions :

i. Differentiate between active ingredient and acid equivalent of herbicides.

ii. What do you mean by 40% W/V of a herbicide?

7c Sub-unit : COMPARATIVE STUDY OF WP AND EC FORMULATIONS

7c.1 Materials required :

i. A wettable powder formulation of herbicide.

ii. An emulsifiable liquid concentrate of herbicide

iii. Beakers

iv. Glass rods

v. Tap water

7c.2 Procedure :

- Take both the formulations and note the name and percentage of active ingredient in them.
- Open the containers and transfer small quantity of herbicides into beakers.
- Observe the nature of formulations
- Add small quantity of water and stir the contents by using a glass rod in both the beakers separately.
- Observe the colour of the final product and nature of solutions.

7c.3 Observations

The pupil should record the observations in the table given below :

Characters	W P	EC
i. Name		
ii. Percentage of active ingredient		
iii. Colour of the formulation		
iv. Nature of the formulation		
v. Colour of the formulation on addition of water		
vi. Nature of the solution after some time.		

7c.4 Expected behavioural outcome

The pupil acquires the following abilities.

	Grade
i. Ability to differentiate two most common types of formulations	
ii. Handling of formulations	

The teacher should evaluate the pupil for the above abilities.

7c.5 Questions

i. Which formulation will give milky white colour on mixing with water?

ii. Why the wettable powders tend to settle at the bottom of the container?

iii. What is wetting agent and what is its use?

iv. What is an emulsifying agent?

7d. Sub Unit : CALIBRATION OF KNAPSACK SPRAYER

7d.1 Relevant information :

- Spray volume rate :

It is defined as volume of spray per unit area and it depends on the nozzle size, pump pressure, the boom length, and the speed with which the sprayer is moved over the ground.

- Why, calibration ? :

The calibration of a sprayer is extremely important in the case of herbicide application to avoid overlapping and under spraying of the area. While the overlapping spray of herbicide will cause crop injury, the under spraying will leave the weeds uncontrolled in many spots.

- Method of calibration :

The most accurate method of calibration of a sprayer is to actually spray water on an area of known size. This method can be used by the aerial sprayer, the farm sprayer or hand sprayer. The size of the area needs to be large enough to give an accurate measurement of the spray applied. The aeroplane operator may need 5 to 10 acres, the tractor sprayer 1 to 2 acres and the hand sprayer 1/20 to 1/10 acre.

7d.2 Precautions :

- Take care that there will not be any variations in the speed and pressure between the test run and actual field spray.
- Use the same manual operator for the calibration and the actual spray.

7d.3 Materials required :

i. A knapsack sprayer
ii. Measuring tape
iii. Water
iv. Measuring cylinders

7d.4 Procedure :

- Take the sprayer and pour exactly two liters of water with the help of measuring cylinder into the tank.
- Go to a field and demarkate a 4 metre wide strip in the field.
- Spray the water uniformly lengthwise covering the 4 metre strip all along. While spraying do not leave any gap between the sprayed areas.
- Start the spraying from one end and cover the area uniformly.
- After spraying out all the 2 litres of water completely, measure the legnth of the area sprayed by the test run using the measuring tape. Let the length be L in metres.

7d.5 Observations and calculations :

The pupil should measure the sprayed area and record it. On the basis of the area covered spray volume required for one hectare should be calculated.

i. Width of the area demarkated = 4 metres

ii. Length of the area sprayed by test run = L

iii. The area sprayed by test run using 2 litres of water = 4 x L sq. m.

iv. The spray volume required for one hectare

$$= \frac{2 \times 10,000}{4 \times L} \text{ Lit/ha}$$

$$= \frac{5000}{L} \text{ Lit/ha}$$

7d.6 Expected behavioural outcome :

The pupil acquires the following abilities.

	Grade
i. Ability to handle sprayer	
ii. Knowledge about the calibration of sprayer.	
iii. Ability to spray the liquid	
iv. Ability to calculate the quantity of spray solution required for a given area.	

The teacher should evaluate the pupil for the above abilities.

7d.7 Questions :

i. Why should we calibrate a sprayer before the application of spray?

ii. Which is the most important factor that affects the spray volume rate in the case of knapsack sprayer?

iii. What will be the effect of overlapped spray on weed control?

iv. What is a cold spot?

8. Activity Unit: SPRAYING OF HERBICIDE TO CONTROL WEEDS IN WHEAT CROP

8.1 Instructional objectives :

The pupil should be able to :

- measure the cropped area.
- calibrate the sprayer.
- calculate the commercial quantity of herbicide for the area.
- prepare desired volume of spray solution.
- apply liquid herbicide correctly, avoiding hazards from spraying.
- determine the effect of spraying on grain yield.

8.2 Relevant information :

- Weed control in wheat :

In wheat, 2,4-D is a suitable herbicide for the control of broad leaved weeds. Its best time of application is 30 days (5-6 leaf stage) after sowing i.e. after the first irrigation at crown root initiation (C R I stage) of the crop has already been given. The optimum dose of ester form of 2,4-D is 0.5 Kg a.e./ha. For the amine and sodium salt, the doses are increased to 0.75 and 1.0 Kg/ha respectively.

Spraying of herbicides is one of the most difficult jobs on the farm. Since neighbouring crops can easily be damaged by carelessness of the spray operator. 2,4-D will easily injure crops like gram, linseed, pea etc. Therefore, spraying of 2,4-D on mixed crops with wheat is never recommended.

8.3 Precautions:

- Identify the weed problem.
- Observe the stage of the crop and plan herbicide spray accordingly.
- Decide about the herbicide formulation and its dose
- Check the weather conditions - spraying during calm and sunny day is preferred.
- Check wind direction to prevent injury to other crops due to drift.
- Check the sprayer and materials properly.

8.4 Materials required :

i. A knapsack sprayer
ii. Measuring cylinder
iii. Measuring tape
iv. Water container (100 litre capacity)
v. Buckets and stick
vi. Herbicide (2,4-D sodium salt or amine or ester)
vii. Protective wears (rubber gloves, eye glass, cloth piece etc)

8.5 Procedure :

- Visit a wheat field already surveyed for weed infestation
- Measure the cropped area and divide it into two equal halves. One to be sprayed with herbicide and another to be kept without spraying.
- Calibrate the knapsack sprayer as explained in Activity Unit 7, sub-unit 7d. Calculate the volume of water required for the area to be sprayed.
- Compute the amount of herbicide (2,4-D) needed.
- Put on hand gloves, eye glass and tie a cloth around your mouth.
- Measure the volume of liquid 2,4-D needed with the help of cylinder and pour it in a bucket. Slowly pour some water in the bucket and stir with a stick to obtain homogenous solution.
- Add this solution to the water container and make up the desired volume.

8.6 (Note : In case herbicide is a wettable powder, first make it into a paste by adding very limited amount of water and then dissolve it slowly by adding more water. Then pour the suspension into the water container to make up the desired volume)

- Undertake spraying operation

8.6 Observations and calculations :

The pupil should record the following observations and calculate the grain yield from the sprayed and control plots separately.

- Observations to be taken before spraying :

i. Number of monocot.weeds ....

ii. Number of dicot weeds..................

- Observation to be taken after 5-6 days of spraying :

i. Number of dicot. weeds affected fully ....

ii. Number of dicot. weeds affected partially......

iii. Number of dict. weeds left unsprayed...........

iv. Number of monocot. weeds affected.............

v. Visual effects on crops plants................

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Effect of spraying on grain yield :

Harvesting of the crop is done in both sprayed and unsprayed plots separately. After threshing of the crop, grain yield is determined on per hectare basis and effect of spraying is judged.

The yield of grain and straw may be recorded as under

	Grain wt. (Kg/ha)	Straw wt. (Kg/ha)
i. Sprayed plot		
ii. Control plot		

Increase in yield due to spraying = ...Kg/ha

Return on each rupee invested = $\dfrac{\text{cost of increased yield}}{\text{cost of spraying operation}}$

=

=

8.7 Expected behavioural outcome :

The pupil acquires the following abilities.

	Grade
i. Ability to measure the area	
ii. Ability to calibrate the sprayer	
iii. Ability to calculate the volume of spray solution for the desired area.	
iv. Ability to work out commercial quantity of herbicide	
v. Ability to observe effect of spraying	
vi. Ability to calculate return on each rupee spent on spraying	

The teacher should evaluate the pupil for the above abilities.

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8.8 Questions :

i. What information do you need before you consider spraying a herbicide in a crop?

ii. Why is sunny day preferred for spraying herbicides?

iii. How can you avoid spray drift?

iv. Why do you nee to know the kind of crops being grown in the surrounding areas before spraying?

v. Why a constant, proper nozzle height is important?

9. Activity Unit : SPRAYING OF HERBICIDE TO CONTROL WEEDS IN SUGARCANE CROP

9.1 Instructional Objectives

The pupil should be able to:

- measure the cropped area
- calibrate the sprayer
- calculate the quantity of herbicide for the area to be sprayed.
- prepare desired volume of spray suspension
- apply spray suspension in right concentration and at right stage, avoiding hazards from spraying.
- Observe the effect of spraying on weed population and growth of sugar cane plants.

9.2 Relevant information :

- Weed infestation in sugarcane - a serious problem, why?

  It is because, the crop receives frequent irrigation and the weather is warm during its growth period. Weeds can reduce the cane yield by as much as 20 to 80%

- Weed control in sugarcane :

  Pre-emergence application of atrazine at the rate of 1 Kg a.i./ha has been found to be a very effective treatment in controlling annaul weeds in sugarcane crop. The herbicide should be sprayed soon after planting cane.

9.3 Precautions :

They are to be followed as per activity Unit 8 para 8.3

9.4 Materials required :

i. Knapsack sprayer
ii. Two buckets
iii. 100 litre drum
iv. Balance with weight box
v. Measuring tape
vi. Herbicide (Atrazine)
vii. Protective outfits and respirator.
viii. Measuring cylinder (1000 ml.)

9.5 Procedure :

- Wear the protective outfits like rubber gloves, eye glass, apron etc.
- Calculate quantity of the commercial product of the herbicide (Atrazine) for the area to be sprayed and weigh the same on a balance.
- Take small amount of water in a backet and dissolve the herbicide slowly to obtain a paste. Then add more water to form a suspension. Pour the concentrated suspension in the drum and make up the volume by adding water.
- Calibrate the sprayer as mentioned in activity Unit 7, sub-unit 7.4

- Fill 3/4 of the tank of the sprayer with measured quantity of suspension.
- Put a mark for the area on the plot to be covered by the suspension while spraying. This will avoid overlaps and gaps.
- Spray the suspension very carefully on the surface of the soil. See that soil surface is covered with spray homogenously.

9.6 Observations :

The pupil should record the following after three weeks of spraying :

i. Number of monocot. weeds......................

ii. Number of dicot. weeds........................

iii. Visiual effect on sugarcane plants when they are 2 - 3 months old..........................

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Similarly the pupil should record the following yield attributing characters at the time of harvest.

	No. of tillers	cane height (cm)
i. Sprayed plot		
ii. Unsprayed plot.		

9.7 Expected behaviour outcome :

The pupil acquires the following abilities:

		Grade
i.	Ability to measure the area	
ii.	Ability to calibrate the sprayer	
iii.	Ability to calculate the volume of spray suspension for the desired area	
iv.	Ability to work out commercial quantity of herbicide.	
v.	Ability to observe the effect of spraying	

The teacher should evaluate the pupil for the above abilities.

9.8 Questions :

i. What general precautions should be taken when applying herbicides?

ii. What factors affect the success of a pre-emergence treatment?

iii. Why should atrazine be applied soon after planting?

iv. How can you ensure optimum soil moisture condition at the time of atrazine application?

v. Why soil should be moist at the time of atrazine application?

vi. Why should interculture be done after atrazine application?

10. Activity Unit : USE OF IMPROVED IMPLEMENTS IN WEED CONTROL

10.1 Instructional Objectives :

The pupil should be able to:

- know the importance of physical weed control in crops,
- handle the implements for weed control,
- assess the effect of weed control by implements on the crop yield.

10.2 Relevant information :

Physical weed control can be very effective if it is done with proper implements and at proper soil condition. It has the advantage of having no chemical hazards to the present or future crops. The following bullock-drawn implements can be used with advantage in a number of broad row crops like sugarcane, maize, sorghum, cotton etc.

- Spike tooth harrow :

It up-roots germinating weed seelings, breaks soil crust and stirs the soil upto 5 cm depth, if worked properly it can create complete weed free environment for crop seedlings.

- Sweep cultivator :

It has three rigid tynes fitted with duck foot type sweeps. The sweeps work below the soil surface and cut the weeds at the root zone. During the operation wet soil is not exposed to the surface, thus utility of this cultivator is extended for the dryland forming as well.

Precautions:

- Check nut -bolts and alignment of the implements.
- Speed with which bullock drawn implements are driven should be kept constant.
- Stage of crop should be considered before deciding to undertake weed control through bullock drawn implements.
- Use implements for weed control only during right moisture condition of the soil.

Materials required :

i. Implements - Spike -tooth harrow or sweep cultivator

ii. Bullock pair with a chain and other accessories.

Procedure :

- Measure the field and divide it into two equal plots : one plot as control without weeding and the other - for weeding with implements.
- Adjust the spikes/tynes of the spike tooth harrow or sweep cultivator according to the distance between two rows of the crop.

- Harrow the field carefully when the seedlings are 4-6 cm tall. Criss-cross harrowing is possible in crops planted by square method e.g. cotton or in crops where sufficient plant-to-plant distance is given.
- Repeat harrowing as and when needed till the crop grows upto 10 - 12 cm tall.
- Remove weeds growing in between plants in the rows manually using any suitable hand tool after every harrowing with cultivator or harrow.

Observations

The pupil should record the following information in the table given below :

Indices	Treated Plot	Untreated Plot
a) Weed density per sq. m.		
i) Number of monocot. weeds.		
ii) Number of dicot. weeds		
b) Effect of inter-row cultivation on crop plants		

Similarly record the weight of the grain and straw (in case of grain-legume crops) from treated and untreated plots in the table given below:

	Grain yield		Straw yield	
	Kg/plot	Kg/ha	Kg/plot	Kg/ha
a) Treated Plot				
b) Untreated Plot				

Expected behavioural outcome :

The pupil acquires the following abilities :

		Grade
i.	Knowledge about physical methods of weed control	
ii.	Ability to undertake weeding through bullock drawn implements.	
iii.	Ability to determine effect of weeding on grain and straw yield	

Questions:

i. Why implements like sweep cultivator should be run at right soil moisture content ?

ii. In most broad-row crops, chemical weed control is followed by inter-row cultivation. Why?

APPENDIX - 1

SAFETY MEASURES IN HERBICIDE USE IN STORAGE

1. Avoid stocking herbicides on the farm; when unavoidable, store herbicides away from fertilizers, seeds, food, and fruits etc.
2. Keep containers air tight to avoid caking or inactivation of herbicides.

SELF PROTECTION

3. Avoid inhaling the spray mist during the operation or preparation of solution.
4. Wear protective outfits and respirator during the operation.

GENERAL

5. Prevent spray drifts to the near-by crops.
6. Wash the sprayer and other accessories with water after the operation is over.
7. Do not mix any other pesticide or fertilizer with the herbicide.
8. Do not spray any other material upto seven days after the herbicide spray.
9. Follow the instructions given on the labels pasted on the containers of herbicides.

APPENDIX - II

TRADE NAMES OF SOME HERBICIDES

S.No.	Trade Name	Generic Name
1.	Arelon 75 WP	soproturon
2.	Atrazine 50 WP	atrazine
3.	Bladex	oyanazine
4.	Basagran	bentazon
5.	Basalin 45 EC	fluchloralin
6.	osanex 80 WP	metoxuron
7.	Eptam	EPTC
8.	Fernoxone	Sodium 2,4-D
9.	Gramoxone	paraquat
10.	Hexanil 35 EC	propanil
11.	Hexapon	dalapon
12.	Hexazine 50 WP	simazine
13.	Igran	terbutryn
14.	Karmex	diuron
15.	Macheta 50 EC	butachlor
16.	MCPA 80 WB	MCPA
17.	Stam F-34	propanil
18.	Tolkan	isoproturon
19.	Tribunil	methabenzthiazuron
20.	Weedone 18 WP	2,4-D ethyl ester
21.	Weedar	2,4-D amine

(This is not an exhaustive list. Teacher should try to collect other names as far as possible through various sources)

APPENDIX - III

SOME MARKETING SOURCES OF

(A) Weeding Implements :

1. BECO Engineering C Ltd., G.T.Road, Batala, Punjab.
2. Cossul & Co. Kanpur, U.P.
3. Escorts Ltd., Faridabad, Haryana.
4. Indian Farm Equipments, Naini, District Allahabad, U.P.
5. M/s Kirloskar Bros. Ltd., Kirloskar Wadi, District Sangli, Maharashtra.
6. Tractor & Farm Equipment Ltd., Madras
7. Voltas Ltd., Ballard Estate, 19-Graham Road, Bombay.

(B) Pesticide Application Equipment :

1. American Spring & Pressing Works Pvt. Ltd., Malad, Bombay.
2. Diamond Equipment Co., 46 Sowripalayam Road, Coimbatore - 4.
3. Indo-German Plantation Machinery Co. Ltd. Bangalore-22.
4. Shaw Wallace & Co. Ltd., 4 Banshall Street, Calcutta-1
5. Sigma Steel Industries, A-2 Industrial Estate, Ludhiana-3

(C) Herbicides :

1. Agromore Ltd., Mysore Road, Bangalore 560026
2. Bayer (India) Ltd. 82 Veer Nariman Road, Bombay - 20 BR.
3. Bharat Pulverising Mill Pvt. Ltd., 14 Queens Road Bombay.

4. BASF India Ltd., Tiecion House, Dr. E.Moses Road,
P.O.B. No.6252, Bombay - 400011

5. CIBA of India Ltd., Khetan Bhawan, P.O.B. No.11014,
Bombay - 20 BR.

6. Cynamid India Ltd., Nyloc House, P.O.B. No.9109,
Bombay - 25 DD

7. Esso Standard Inc. Pvt. Ltd., P.O.B.No.355,
Bombay-1 WB

8. Farm Chemicals Ltd., Jiji House, Raveline Street,
Bombay-400001.

9. G.Mahalingam, D-52 Panchsheel Enclave, New Delhi -17
(for Stauffer Chemical Co. Cal. USA)

10. Hoecht Pharmaceuticals Ltd., P.O.B.No.2,
Ahmedabad - 380001.

11. Hindustan Petroleum Corporation Ltd.,
P.O.B.No.4032, Ahmedabad - 380009.

12. Imperial Chemical Industries, 18 Strand Road,
Calcutta.

13. Indofil Chemicals Ltd., Mirlon House, Bombay-400025

14. Imkemex India Ltd., P.O.B.No.287, Bombay-400038

15. Monsanto Chemicals of India Pvt. Ltd.
P.O.B. No.705, New Delhi.

16. National Organic Chemical Industries Ltd.,
Sandoz House, Bombay-18.

17. Rallis India Ltd., 21 Ravelin St., Bombay-18 400001

18. Sandox (India) Ltd., P.O.B. No.6596, Bombay -18 WB

19. Sigma Chemical Industries, Picnic Park, Calcutta-29.

20. The Alkali & Chemicals Corporation of India Ltd.
34, Chowringhee Road, Calcutta- 700016.

21. Union Carbide India Ltd., P.O.B. No.46, Bhopal (M.P.)

22. Velsicol Corporation of India, J-30 South Extension,
New Delhi - 49.

Questionnaire for Collecting Opinion Of
Teachers And Students On The
INSTRUCTIONAL-CUM-PRACTICAL MANUAL

ON

WEEDS AND WEED CONTROL

VOCATIONALIZATION OF EDUCATION UNIT
National Council of Educational Research & Training
Sri Aurobindo Marg, New Delhi - 110016

1982

Dear Teacher/Student,

We are happy to place this Instructional-cum-Practical Manual at your disposal with the hope that it will help you conduct some of the practical works prescribed in the syllabus or practices necessary to gain thorough vocational expertise.

The Manual does not conform to syllabus of any particular state but includes most of the important activities common in syllabi of different states. This is an experimental edition with ample scope for further improvement through feed-back from you. We solicite your active co-operation for the improvement of the Manual.

After having used the Manual for a year or more, kindly read the appended questionnaire carefully and write down the answers precisely and exactly to-the-point. Use additional sheet of paper if the space provided for is insufficient. Fold the questionnaire accurately and mail it to the following address :

The Head,
Vocationalization of Education Unit,
National Council of Educational
Research & Training,
Sri Aurobindo Marg,
NEW DELHI - 110016

QUESTIONNAIRE FOR THE TEACHERS

INSTRUCTIONAL-CUM-PRACTICAL MANUAL ON_______________

A. Name of the Teacher
(in block letters) ___________________________

B. Name & postel address
of the Institution :__________________________

____

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C. i) Qualification___________________________

ii) Teaching Experience______________________

iii) Professional or
Field Experience__________________________

____

1. Do the activities covered in the Manual develop vocational expertise in the students?

Yes/No

2. List the activities included in the Manual which do not figure in the syllabus

3. List the activities included in the Manual which do not figure in the syllabus, but are vocationally important

4. List the activities prescribed in the syllabus but not covered in the Manual

5. List the vocationally important activities which are neither included in the Manual nor prescribed in the syllabus.

6. a) Does the relevant information given under every activity unit furnish enough theoretical background of the activity?

Yes/No

b) If not, list the activity units where relevant information needs further modification.

Activity Unit	Portion	Type of modification needed

7. a) Does the relevant information contain any factual errors or inaccuracies?

Yes/No

b) If yes, give the details

Activity Unit	Error/Inaccuracy	Should read

8. Did you notice any expressions/sentences in the manual which do not carry precise meaning or information? If yes, then give the details:

Page No.	Expression/Sentence	Would be more appropriate

9. Are instructional objectives pertaining to each activity unit rational? If not, list down the irrational, irrelevant or vague ones.

Activity Unit	Irrational/irrelevant/ vague objective

10. Does accomplishment of the activity units result in realization of objectives in terms of behavioural outcomes in the students? If not, point out the behavioural outcomes mentioned in the manual, which you feel are difficult to achieve through a particular activity unit?

Activity Unit	Behavioural outcome

11. Is the procedure for activity units well sequential? If not point out the discrepancies along with your own observations or suggestions.

Activity Unit	Discrepancy	Observation/ suggestions

12. Did you notice any inaccuracies/discrepancies in the diagrammes illustrating activity Units? If yes, point them out.

Illustration No.	Discrepancy/ Inaccuracy

13. Your overall opinion about the Manual which may be useful in the effective improvement of the manual.

QUESTIONNAIRE FOR THE STUDENTS

INSTRUCTIONAL-CUM-PRACTICAL MANUAL ON ____________________

A. Name of the Student
(in block letters) ____________________

B. Name and address of
the school/college ____________________

____

C. Class ____________________

D. Medium of instruction ____________________

1. Enlist the portions of the Manual which you found difficult to understand and give reasons.

Activity Unit	Portion of the Text	Difficulty experienced

2. Mention the places where you found the language to be difficult.

Activity Unit	Page No.	Difficulty experienced

3. Point out the figures/illustrations which do not help in understanding the topic/theme.

Illustration No.	Your observations/ difficulty experienced

4. Can you conduct the activity units yourself with the help of this manual?

Yes/No

If not, point out the portions of activity units which need further elaboration or explanation.

Activity Unit	Portions to be elaborated

5. Was theoretical information given in the Manual useful to you in the examination?

Yes/No

6. Do you now know the scientific reason behind steps that you take in the conduct of different activity units?

Yes/No

7. Your overall candid opinion about the Manual.